EXHIBIT A

USSR Inventor's Certificate No. 699654

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910 West Avenue, Austin, Texas 78701 USA

UNION OF SOVIET SOCIALIST REPUBLICS
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On Matter of Inventions and Discoveries
DESCRIPTION OF INVENTION
For Inventor's Certificate of 699654

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ULTRASONIC DELAY LINE

Inventor:	B. V. Dyudin
Applicant:	Taganrog Radio Engineering Institute named for V. D. Kalmykov

The invention relates to radioelectronics and can be used in devices for delay of electrical signals.

There are known three-dimensional wave type ultrasonic delay lines, in which solid waveguides in the form rectangular blocks serve as acoustic lines. Multiple reflections of the ultrasonic beam within the waveguide are used to obtain large delay times [1].

However, such lines are cumbersome and, moreover, lack smooth regulation of the delay time. This is partially eliminated in normal wave type ultrasonic delay lines, where metal strips serve as acoustic lines.

There are known normal λ wave type delay lines containing a strip waveguide and λ wave converter made in the form of a prism of a dielectric material with a piezoelement situated on its beveled face, which is positioned at one end of the waveguide. The prism is oriented in the direction of wave propagation and can move along the waveguide [2].

However, losses in conversion of the electric pulse to an acoustic pulse and back are as high as 60-80 dV in such a line. Regulation of the delay tie in this case is accomplished by moving one of the converters along the waveguide, which can lead to disruption of acoustic contact.

The goal of the invention is a reduction of losses and simplification of control of the delay time.

This is achieved by the fact that part of the strip waveguide at the other end is rolled into a spiral and positioned in a vessel containing a liquid with the capability of changing the degree of immersion, and the electroacoustical λ wave converter is oriented in the direction opposite the direction of wave propagation through the waveguide.

The drawing shows the proposed device, general view.

The delay line consists of strip waveguide 1, at the free end of which is affixed prism 2 with piezoelement 3. The prism is oriented in the direction opposite to the direction of wave propagation. The other end of the waveguide is coiled into a spiral, connected to device 4 for regulation of immersion, and positioned in vessel 5, which contains a liquid.

The electrical pulse is converted by the piezoelectric element 3 into an elastic pulse, which propagates in prism 2 and, upon reaching the surface of waveguide 1, induces an ultrasonic inverse wave in it. The ultrasonic signal propagates through the waveguide to the interface with the liquid, is reflected and goes back to prism 2 and piezoelement 3, where it is again converted to an electric signal.

The angle of introduction of ultrasonic vibrations into the waveguide is chosen to be equal to the angle of excitation of the inverse wave. The delay time is dependent on the length of the free end of the waveguide and is determined from the reflected signal from the gas-liquid interface. Regulation of the delay time is accomplished by changing the degree of immersion of the waveguide into the liquid.

The proposed delay line has low losses in conversion of the electrical signal to an ultrasonic signal and back, has a simple design, and is characterized by ease of regulation of the delay time.

Claim

An ultrasonic delay line consisting of a strip waveguide and, situated at one of its ends, an electroacoustical λ wave type converter made in the form of a prism of a dielectric material with a piezoelement situated on its beveled face, which is distinguished by the fact, with the goal of reducing losses and simplifying the regulation of the delay time, a part of the strip waveguide at the other end is rolled into a spiral and is positioned in a vessel containing a liquid, with the capability of changing the degree of immersion, and the electro-acoustic λ wave converted is oriented in the direction opposite the direction of propagation of waves through the waveguide.

Sources of information considered in examiner's evaluation:

1. A. G. Sokolinskii, "Magnetic Ultrasonic Delay Lines," Soviet Radio [in Russian]. Moscow, 1966, p. 81.

2. I. A. Viktorov, Physical Principles of the Use of Ultrasonic Rayleigh and Lambda Waves in Industry [in Russian]. Moscow, Nauka, 1966, pp. 154-161 (prototype).